

1. An apparatus for use with a radiolucent skull clamp supporting a head of a patient comprising:

a skull pin assembly adapted to be mounted with respect to the skull clamp, the skull pin assembly comprising a skull pin adapted to be movable into contact with the head of the patient; and

a pin load applicator removably connectable to the skull pin assembly and comprising

a loading shaft in mechanical communication with the skull pin,

a biasing element operable to apply a force on the loading shaft, the loading shaft in turn transferring the force to the skull pin contacting the head of the patient, and

a load force indicator connected to the loading shaft and providing an indication of the force being applied by the skull pin contacting the head of the patient,

the pin load applicator being movable to adjust the force applied by the skull pin contacting the head of the patient, and thereafter, the pin load applicator being removable from the skull pin assembly without changing the force being applied by the skull pin contacting the head of the patient.

2. The apparatus of claim 1 wherein the skull pin assembly can be fixed at a desired position with respect to the skull clamp.

3. The apparatus of claim 1 wherein the skull pin assembly is linearly movable with respect to the skull clamp.

4. The apparatus of claim 1 wherein the skull pin assembly further comprises an engagement shaft adapted to be movable in a linear direction with respect to the skull clamp and the motion of the engagement shaft in the linear direction is limitable.

5. The apparatus of claim 1 wherein the pin load applicator is movable with respect to the skull clamp to bring the loading shaft in contact with the engagement shaft and to apply the force to the skull pin contacting the head of the patient.
6. The apparatus of claim 1 wherein the biasing element applies a force against the loading shaft in a direction toward an interior of the skull clamp.
7. The apparatus of claim 1 wherein the biasing element is a compression spring.
8. The apparatus of claim 1 further comprising an insert adapted to be mounted to the skull clamp, the insert receiving and supporting the skull pin assembly.
9. The apparatus of claim 8 wherein the skull clamp has a bore at one end and the insert is adapted to be rigidly mounted in the bore.
10. The apparatus of claim 8 wherein the skull pin assembly further comprises an engagement shaft adapted to be slidable but not rotatable with respect to the skull clamp.
11. The apparatus of claim 10 wherein skull pin assembly further comprises a lock nut threaded on an inner end of the engagement shaft to limit slidable motion of the engagement in a direction extending outward from the skull clamp.
12. The apparatus of claim 11 wherein the skull pin assembly further comprises a piston supported by the engagement shaft and connected to the skull pin.
13. The apparatus of claim 12 wherein the piston is threaded within the engagement shaft and movable to change a length of the skull pin assembly.

14. The apparatus of claim 12 wherein the skull pin is supported by an inner end of the piston.

15. The apparatus of claim 10 wherein the pin load applicator is threadably mountable on the insert to bring the loading shaft in contact with the engagement shaft.

16. The apparatus of claim 10 wherein the loading shaft has a plunger on the inner end, the plunger contacting one end of the biasing element and receiving the force therefrom and transmitting the force to the engagement shaft.

17. The apparatus of claim 1 wherein the skull pin assembly is made from only radiolucent materials and the removable pin load applicator comprises a nonradiolucent material.

18. A skull clamp for supporting a head of a patient comprising:
- a clamp body having opposed first and second ends;
  - a first skull pin assembly adapted to be mounted with respect to the first end of the clamp body, the first skull pin assembly comprising a first skull pin adapted to be movable into contact with the head of the patient;
  - a pin load applicator removably connectable to the first skull pin assembly and comprising
    - a loading shaft in mechanical communication with the first skull pin,
    - a biasing element operable to apply a force on the loading shaft, the loading shaft in turn transferring the force to the first skull pin contacting the head of the patient, and
    - a load force indicator connected to the loading shaft and providing an indication of the force being applied by the first skull pin contacting the head of the patient;
- the pin load applicator being movable to adjust the force applied by the first skull pin contacting the head of the patient, and thereafter, the pin load applicator being removable from the first skull pin assembly without changing the force being applied by the first skull pin contacting the head of the patient; and
- a second skull pin mounted with respect to the second end of the clamp body and adapted to contact the head of the patient.

19. The skull clamp of claim 18 further comprising:

a third skull pin assembly mounted with respect to the first end of the clamp body and comprising a third skull pin adapted to contact the head of the patient, the third skull pin assembly being removably connectable with the pin load applicator to bring the loading shaft in mechanical communication with the third skull pin, the pin load applicator being movable to adjust the force applied by the third skull pin contacting the head of the patient, and thereafter, the pin load applicator being removable from the second skull pin assembly without changing the force being applied by the third skull pin contacting the head of the patient.

20. The skull clamp of claim 19 wherein the second skull pin further comprises a second skull pin assembly removably connectable with the pin load applicator to bring the loading shaft in mechanical communication with the second skull pin, the pin load applicator being movable to adjust the force applied by the second skull pin contacting the head of the patient, and thereafter, the pin load applicator being removable from the second skull pin assembly without changing the force being applied by the second skull pin contacting the head of the patient.

21. The skull clamp of claim 20 wherein the clamp body and the first skull pin assembly, the second skull pin assembly and the third skull pin assembly comprise a radiolucent material and the pin load applicator comprises a nonradiolucent material.

22. A skull clamp for supporting a head of a patient comprising:

- a clamp body having opposed first and second ends;
- a swivel having one end rotatably mounted with respect to the first end of the clamp body, the swivel being rotatable about an axis of rotation;
- a rocker arm pivotally mounted to an opposite end of the swivel;
- a first skull pin mounted at one end of the rocker arm and adapted to be movable into contact with the head of the patient;
- a second skull pin mounted at an opposite end of the rocker arm and adapted to be movable into contact with the head of the patient;
- a skull pin assembly mounted with respect to the second end of the clamp body, the skull pin assembly comprising a third skull pin adapted to be movable into contact with the head of the patient; and
- a pin load applicator removably connectable to the third skull pin assembly, the pin load applicator comprising
  - a loading shaft in mechanical communication with the third skull pin,
  - a biasing element operable to apply a force on the loading shaft, the loading shaft in turn transferring the force to the third skull pin contacting the head of the patient, and
  - a load force indicator connected to the loading shaft and providing an indication of the force being applied by the third skull pin contacting the head of the patient;

the pin load applicator being movable to adjust the force applied by the third skull pin contacting the head of the patient, and thereafter, the pin load applicator being removable from the skull pin assembly without changing the force being applied by the third skull pin contacting the head of the patient.

23. The skull clamp of claim 22 further comprising a clevis on the opposite end of the swivel for pivotally supporting the rocker arm.

24. A method of applying a desired clamping force on a skull supported by a skull clamp, the method comprising:

- providing a skull pin assembly mounted on, and movable with respect to, the skull clamp, the skull pin assembly comprising a skull pin contacting the skull;

- removably attaching a pin load applicator to the skull pin assembly, the pin load applicator comprising

  - a loading shaft in mechanical communication with the skull pin assembly,

  - a biasing element operable to apply a force against the loading shaft, the loading shaft in turn transferring the force to the skull pin contacting the skull, and

  - a load force indicator connected to the loading shaft and providing an indication of the force being applied by the skull pin contacting the skull,

- moving the pin load applicator in a first direction with respect to the skull clamp to apply a force against the loading shaft and the skull pin contacting the skull;

- terminating motion of the pin load applicator in the first direction in response to the load force indicator indicating the force being equal to a desired value;

- limiting motion of the skull pin assembly in a second direction opposite the first direction and holding the force at the desired value;

  - moving the pin load applicator in the second direction; and

  - removing the pin load applicator from the skull pin assembly.